

STEREO MOC Status Report
Time Period: 2015:180 - 2015:186

STEREO Ahead (STA) Status:

1. The following Ground System anomalies/events occurred during this reporting period:

- On day 180, during the DSS-14 support, after the 32nd HCLT initiated system reset with the observatory rotating at 5 degrees per minute on the 2nd HGA side lobe, telemetry was received for 65 minutes during each 72 minute rotation. 488 good telemetry frames or 65% of the expected frames were received.
- On day 181, during the DSS-63 support, with the observatory rotating at 5 degrees per minute on the -Z LGA, telemetry lock was never received due to the low signal strength as the LGA is on the edge of the hemispherical pattern. Carrier lock was solid throughout the support with the carrier power between -169 and -172 dBm.
- On day 182, during the DSS-43 support, with the observatory rotating at 5 degrees per minute on the +Z LGA, telemetry lock was never received due to the low signal strength as the LGA is on the edge of the hemispherical pattern. Carrier lock was good, with occasional drop outs, with the carrier power between -169 and -174 dBm.
- On day 183, during the DSS-14 support, after the 33rd HCLT initiated system reset with the observatory rotating at 5 degrees per minute on the 2nd HGA side lobe, telemetry reception was very poor, most likely due to solar interference from a CME, with only 81 good telemetry frames or 13% of the expected frames were received.
- On day 184, during the DSS-43 support, with the observatory rotating at 5 degrees per minute on the -Z LGA, telemetry lock was never received due to the low signal strength as the LGA is on the edge of the hemispherical pattern. Carrier lock was good, with intermittent drop outs for several minutes, with the carrier power between -168 and -170 dBm.

- On day 185, during the DSS-14 support, with the observatory rotating at 5 degrees per minute on the +Z LGA, telemetry lock was never received due to the low signal strength as the LGA is on the edge of the hemispherical pattern. Carrier lock was good, with occasional drop outs, with the carrier power between -168 and -174 dBm.
- On day 186, during the DSS-43 support, after the 34th HCLT initiated system reset with the observatory rotating at 5 degrees per minute on the 2nd HGA side lobe, telemetry was received for 66 minutes during each 72 minute rotation. 847 good telemetry frames or 94% of the expected frames were received.

2. The following spacecraft/instrument events occurred during this week.

- On day 180, June 29th, after the 32nd HCLT initiated system reset at a 1.6 degree SPE angle, the DSN received a strong downlink signal again from STEREO AHEAD post superior solar conjunction at 2303z. The observatory was operating nominally, rotating as planned at 5 deg/min while communicating on the 2nd HGA side lobe. The IMPACT and PLASTIC space weather SSR partitions are unchanged, 53 and 51 percent full respectively, and SWAVES, which continues to be on recording at one packet per minute, was at 49.9 percent full. The HGA feed temperature remains within the predicted range at 113 degrees C. System momentum was constant at the anticipated level of 8.0 Nms. As occurred during solar conjunction entry, after the 32nd HCLT reset, the star tracker was again "lazy" in re-acquiring a solution causing IMU2 to power on for two hours. G&C reaction wheel #3 continued to not respond to G&C torque commands.
- On day 183, July 2nd, after the 33rd HCLT initiated system reset at a 1.7 degree SPE angle, the DSN received a strong downlink signal again from STEREO AHEAD post superior solar conjunction at 1515z. The observatory was operating nominally, rotating as planned at 5 deg/min while communicating on the 2nd HGA side lobe. The IMPACT and PLASTIC space weather SSR partitions are unchanged, 53 and 51 percent full respectively, and SWAVES, which continues to be on recording at one packet per minute, was at 50.5 percent full. The HGA feed temperature remains within the predicted range at 113 degrees C. System momentum was constant at the anticipated level of 8.0 Nms. As occurred

during solar conjunction entry, after the 33rd HCLT reset, the star tracker was again "lazy" in re-acquiring a solution causing IMU2 to power on for two hours. G&C reaction wheel #3 continued to not respond to G&C torque commands.

- On day 186, July 5th, after the 34th HCLT initiated system reset at a 1.8 degree SPE angle, the DSN received a strong downlink signal again from STEREO AHEAD post superior solar conjunction at 1408z. The observatory continues to operate nominally, rotating as planned at 5 deg/min while communicating on the 2nd HGA side lobe. The IMPACT and PLASTIC space weather SSR partitions are unchanged, 53 and 51 percent full respectively, and SWAVES, which continues to be on recording at one packet per minute, is at 51.0 percent full. The HGA feed temperature remains within the predicted range at 113 degrees C. System momentum is at 7.8 Nms. As occurred during solar conjunction entry, after the 34th HCLT reset, the star tracker was again "lazy" in re-acquiring a solution causing IMU2 to power on for two hours. G&C reaction wheel #3 continues not responding to G&C torque commands. While the observatory continues to rotate nominally and is designed to do so with three reaction wheels, after reviewing hardware simulator and G&C standalone simulation results for transitioning to 3-axis control, wheel #3 G&C control will be disabled on July 8th. Further contingency response to this G&C anomaly will be conducted after G&C SSR data is downlinked and analyzed. Detailed G&C anomaly data, which was captured on the SSR, may take 6 weeks to receive, due to the low downlink rate on the 2nd HGA side lobe and depending upon when the anomaly occurred.

STEREO Behind (STB) Status:

1. The following Ground System anomalies/events occurred during this reporting period:
 - None.
2. Detailed status of the activities that occurred on the Behind loss of communication anomaly, which occurred on day 2014-274, are listed below.
 - The Behind observatory entered superior solar conjunction at the 2.0 degree SPE angle on day 022. Recovery efforts

resumed post solar conjunction on day 124, May 4th through day 178, June 27th, as the spacecraft had cleared solar interference for LGA communications. The Failure Review Board recommendations were implemented consisting of battery state of charge recovery and powering on the downlink carrier. The Green Bank Radio Telescope and the Arecibo Observatory also observed the carrier recovery tracks. To date, no downlink signal has been detected from the Behind observatory. Due to Behind's retrograde motion causing it to re-enter the region of solar interference, recovery operations will be suspended from July through November. The Failure Review Board's recommended faster frequency segmented acquisition sequence will be tested with the Ahead observatory in September. The DSN uplink arraying capability will be tested again with the Ahead observatory in October and November, and when it is ready, it will be used to increase the spacecraft received signal power to assist with Behind recovery commanding. With time the spacecraft range improves RF communications and the ability for other assets to acquire data on Behind. LGA uplink margin returns to 6 dB for the 7.8 bps rate in March 2016 and 125 bps in December 2019 and the LGA downlink margin returns to 3 dB for the 12 bps rate in December 2016 and 35 bps in March 2018.

Significant findings to date:

1. Analysis of the three DSN extracted telemetry frames from the carrier signal just before the planned observatory reset/anomaly occurred on day 2014-274, October 1st, showed nominal performance of the spacecraft, i.e., no anomalies, IMU off, and the star tracker providing an attitude solution.
2. Post reset, from the very limited telemetry, three packets, extracted from the carrier signal by the DSN, the X-axis gyro on IMU-A had failed. Unfortunately, this telemetry contained only G&C anomaly data and no spacecraft summary data, i.e., the state of the RF, G&C, fault protection and other subsystems is not known at the time of the anomaly. With a failed IMU and the star tracker being off-line for an undetermined duration, the sun sensors will keep the observatory pointed at the Sun, though the G&C will not have any roll knowledge, and cannot roll the observatory as part of the safing configuration to re-establish communications on the LGAs. From analysis of

this telemetry and initial G&C simulations, it is highly suspected that the observatory is rotating about the principal axis of inertia due to an autonomous momentum dump initiated by biased gyro data flagged good by the IMU, but this has not yet been confirmed.

3. At least two anomalies occurred post reset, the star tracker not promoting to AAD mode and the X-axis gyro failure. Unfortunately, due to the number of possible combinations, the STEREO fault protection system is not designed for simultaneous failures.

The cause and effect analysis of the loss of communications from the LGAs is continuing. G&C simulations using the biased gyro data flagged good by the IMU are continuing to better understand the potential impact to the observatory state. Recovery from a negative power state is also being investigated. While the recovery and analysis efforts continue on Behind, as the Ahead observatory will enter superior solar conjunction in March, the primary focus of the engineering team is on developing operational configuration changes to add robustness to the G&C rate sensor usage to ensure the Ahead observatory's continued safety.

Once communications are restored and the anomaly resolved, the Behind observatory will be returned to nominal science data collection as soon as it is safely possible.